(54) **Silence compression coding/decoding method and device**

(57)   A silence compression coding / decoding method and device of the same enables sound quality of background noise at the time of decoding and transmission efficiency to be improved while selecting either silence compression coding processing or regular coding processing corresponding to background noise level of input speech signal in digital image / speech transmission. A background noise measuring section compares background noise component level 'Sm' in every input frame with discrimination threshold value data 'Srf' in background noise level discrimination section. When the background noise component level 'Sm' exceeds the discrimination threshold value data 'Srf', switches SW1, SW2 select coder (regular coding processing). When the background noise component level 'Sm' does not exceed the discrimination threshold value data 'Srf', switches SW1, SW2 select silence compression correspondence coder (silence compression coding processing). Thus each result of selection is transmitted to decoder. The decoder implements either regular decoding processing or decompression decoding processing according to inactive / active flag stored in frame transmitted from a silence compression coding selector. When the background noise level is large, the device reduces sound quality deterioration of the background noise at the time of decoding while implementing regular coding processing.

FIG. 2

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a silence compression coding / decoding method and device of the same. More to particularly, this invention relates to a silence compression coding / decoding method and device of the same which selects either silence compression coding or speech compression coding processing (appropriately, referred to as regular coding processing) corresponding to background noise level of input speech signal at a transmission side to implement a coding transmission and which implements decoding at the reception side in digital image / speech transmission.

Description of the Prior Art

[0002] Formerly, in a video telephone system and / or a video conference system which implements transmission of this kind of digital image / speech, the system causes an input signal of analog image / speech to be subjected to sampling and quantization, before undergoing coding and compression in conformity with transmission protocol to transmit. For instance, a video signal of 4MHz band is compressed together with PCM digital coding, resulting in compression of 1.5 M bit / s (ITU-T / MPEG-1 Standard-Low Bit Rate Video Image Coding System Recommendation) to transmit through ISDN or PSTN. In a reception side, a decoding for inverting the received compressed signal into discrete PAM pulse string with respect to time is implemented, before generating analog image signal by low pass filtering.

[0003] In such the speech transmission, a part of 30 to 60 % in conversation is in-active interval such as break of conversation (there exists silence and background noise). In this in-active interval, the speech transmission method enlarges a compression coding ratio, and lessens coding data, thus reducing transmission band exceedingly in order to enhance transmission efficiency. Discrimination regarding in-active interval or active interval is implemented in such a way that threshold value is established in order to compare sampling value with the threshold value. When such the silence compression coding processing is used, the transmission band becomes narrow because of large compression ratio. Namely, data transmission quantity is low, thereby, difference between input speech signal (original sound) before transmission and decompressed data becomes large according to decompression at the time of decoding, especially, deterioration of sound quality of the background noise is easy to occur.

[0004] Fig. 1 is a block diagram showing a device constitution regarding conventional silence compression coding / decoding method.

[0005] The device causes digital input speech signal to be coded using a coder 1 to transmit to a decoder 3 through a transmission line 2. Here, decoded analog output speech signal is transmitted. The coder 1 and the decoder 3 are fixed devices provided with function either silence compression coding function or non silence compression coding function. The device notices the active / in-active flags from the coder 1 to the decoder 3 through the transmission line 2 to implement either regular decoding or decompression decoding.

[0006] In the silence compression coding processing, particularly, the device enlarges compression coding ratio of the in-active interval and the device reduces the transmission band to enhance the transmission efficiency. In other words, this processing is compression coding processing to the speech signal. Consequently, when the compression ratio is large in relation to the background noise exception for the speech signal, especially, deterioration of sound quality becomes remarkable, thus this becomes a main cause of speech deterioration of the background noise in the video telephone system, or the video conference system.

[0007] In order to improve these defects, for instance, Japanese Patent Application Laid-Open No. HEI 4-357735 "SPEECH PACKET COMMUNICATION DEVICE" as being the conventional example, discloses that when the device detects in-active interval at the side of transmission, the device transmits a packet of information of this noise level, while at the side of reception, the device inserts background noise of in-active interval according to information of received noise level to implement appropriate regeneration, thus the device causes no noise level difference to generate at the time of conversation from the in-active interval to the active interval.

[0008] Further, the conventional example of the Japanese Patent Application Laid-Open No. HEI 9-162892 "ATM IN-ACTIVE COMPRESSION METHOD" discloses that the device detects to store in-active parts within 47-bite of payload data on the inside of ATM cell, before regenerating thereof according to demand, thus the device does not generate ATM cell to be useless transmission, and the device reduces a sense of incompatibility at the time of regeneration, and it is capable of using transmission band efficiently.

[0009] Thus, in the above described conventional example, it is capable of being performed appropriate regeneration (decoding), and difference of noise level does not generate at the time of a conversion from in-active interval to active interval. Further, the conventional device does not transmit unnecessary ATM cell, thereby, the transmission band can be used efficiently, and a sense of compatibility is reduced at the time of regeneration. However, in this case the conventional device always performs silence compression coding processing in regard to background noise before transmitting it. Therefore, when the device implements this decoding, there occurs defect that sound quality of the background noise deteriorates at the time of regeneration (decoding), thus there is the defect that a telephone call becomes a call which is disagreeable to listen.

SUMMARY OF THE INVENTION

[0010]   In view of the foregoing, it is an object of the present invention, in order to overcome the above mentioned problem, to provide a silence compression coding / decoding method and device of the same which is capable of selecting silence compression coding processing or speech compression coding processing (regular coding processing) corresponding to background noise level of input speech signal, thus sound quality of the background noise at the time of decoding is improved, the transmission efficiency is improved, and device scale is reduced, and degrees of freedom of constitution (design) is obtained.

[0011]   In accordance with a first aspect of the present invention, in order to achieve the above mentioned object, there is provided a compression coding / decoding method in which an in-active interval of an input speech signal is subjected to a compression coding before implementing decompression decoding, comprising the steps of picking out a background noise component in every input frame, comparing background noise level of the background noise component in every input frame with a discrimination threshold value, and selecting regular coding processing when background noise component level exceeds the discrimination threshold value in every input frame, while when background noise level does not exceed the discrimination threshold value, compression coding processing is selected in every input frame.

[0012]   In accordance with a second aspect of the present invention, there is provided a compression coding / decoding method in which an in-active interval of an input speech signal is subjected to a compression coding before implementing decompression decoding, comprising the steps of picking out a background noise component of a first frame of the input speech signal, comparing background noise level of the background noise component of the first frame with a discrimination threshold value, and selecting regular coding processing in subsequent frames when background noise component level of the first frame exceeds the discrimination threshold value in every input frame, while when background noise level of the first frame does not exceed the discrimination threshold value, compression coding processing is selected in subsequent input frame.

[0013]   In accordance with a third aspect of the present invention, in the first or the second aspect, there is provided a silence compression coding / decoding method, wherein the discrimination threshold value is any of a fixed value determined previously, a semi-fixed value according to manual establishment, and a variable establishment value variably established automatically by control signal from outer section.

[0014]   In accordance with a fourth aspect of the present invention, in the first or the second aspect, there is provided a silence compression coding / decoding method, wherein the coding processing notices either an in-active flag or an active flag indicating either silence compression processing or speech compression coding processing toward decoding side, thus implementing either decompression decoding processing or non-decompression decoding processing according to this notification.

[0015]   In accordance with a fifth aspect of the present invention, there is provided a silence compression coding / decoding device having a coder and decoder, for implementing compression coding to an in-active interval of an input speech signal, before implementing decompression decoding thereto, wherein the coder comprises a coding means for coding an input speech signal to output in every frame, a compression coding means for compression coding the input speech signal to output in every frame, a background noise measuring means for picking out a background noise component in every frame of the input speech signal, a background noise level discrimination means for comparing a background noise level from the background noise measuring means with a discrimination threshold value in every frame, and a selecting means, in the background noise level discrimination means, for selecting the coding means in every frame when background noise component level exceeds the discrimination threshold value, while when the background noise level does not exceed the discrimination threshold value, the selecting means selects the compression coding means in every frame.

[0016]   In accordance with a sixth aspect of the present invention, there is provided a silence compression coding / decoding device having a coder and decoder, for implementing compression coding to an in-active interval of an input speech signal, before implementing decompression decoding thereto, wherein the coder comprises a coding means for coding an input speech signal to output, a compression coding means for compression coding the input speech signal to output, a background noise measuring means for picking out a background noise component from the input speech signal in a first frame, a background noise level discrimination means for comparing a background noise level from the background noise measuring means with a discrimination threshold value in the first frame, and a selecting means, in the background noise level discrimination means, for selecting the coding means in subsequent frame when background noise component level of the first frame exceeds the discrimination threshold value, while when the background noise level of the first frame does not exceed the discrimination threshold value, said selecting means selects said compression coding means in subsequent frame.

[0017]   In accordance with a seventh aspect of the present invention, in the fifth aspect or the sixth aspect, there is provided a silence compression coding / decoding device, further comprising an establishing means for establishing the discrimination threshold value as a fixed value determined beforehand.

[0018]   In accordance with an eighth aspect of the present invention, in the fifth aspect or the sixth aspect, there is provided a silence compression coding / decoding device, further comprising a manual operation variable establishing means for establishing the discrimination threshold value as a semi-fixed value according to manual operation establishment.

[0019]   In accordance with a ninth aspect of the present invention, in the fifth aspect or sixth aspect, there is provided a silence compression coding / decoding device, further comprising an automatic variable establishing means for automatically establishing variably the discrimination threshold value according to control signal from an external section.

[0020] In accordance with a tenth aspect of the present invention, in the fifth aspect or the sixth aspect, there is provided a silence compression coding / decoding device, wherein the background noise measuring means picks out the background noise component in such a way that the background noise measuring means extracts speech band component from the frame of the input speech signal before implementing subtraction processing in order to subtract the speech band component of the frame.

[0021] In accordance with an eleventh aspect of the present invention, in the fifth aspect or the sixth aspect, there is provided a silence compression coding / decoding device, wherein when the coder implements coding processing, the coder transmits either an in-active flag or an active flag indicating either silence compression coding processing or speech compression coding processing to the decoder, before the decoder implements either decompression decoding processing or non-decompression decoding processing according to this notification, and wherein the coder stores the in-active flag or the active flag in the frame before transmitting the flag in order to notice to the decoder.

[0022] Such the silence compression coding / decoding method and the device of the same of the present invention, the device compares the background noise component level picked out in every frame of the input speech signal with the discrimination threshold value, thus when the background noise component level exceeds the discrimination threshold value, the device selects the regular coding processing, while when the background noise component level does not exceed the discrimination threshold value, the device selects the silence compression coding processing, before transmitting either coding data or silence compression coding data.

[0023] Thus, the device is capable of selecting either silence compression coding processing or speech compression coding processing (regular coding processing) corresponding to background noise level of the input speech signal in the video image / speech transmission and so forth. In such the case, when the background noise always undergoes the silence compression coding processing to be subjected to the decoding, sound quality of the background noise deteriorates, thus speech is disagreeable to listen, therefore, either the silence compression coding processing or the speech compression coding processing (regular coding processing) is selected while comparing the background noise component level 'Sm' with the discrimination threshold value data 'Srf' so as not to come to be disagreeable to listen to.

[0024] As a result thereof the transmission efficiency deteriorates slightly in comparison with the case where the whole background noise undergoes the silence compression coding processing, however, the transmission efficiency does not deteriorate largely, thus the transmission efficiency is improved. Further, the background noise does not generate deterioration of sound quality, thus speech quality is improved, resulting in high quality of speech.

[0025] Further, the silence compression coding / decoding method and the device of the same of the present invention compares the background noise level of the background noise component in the first frame of the input speech signal. Namely, in the middle of the speech, the speaker does not move from the place, in the circumferential environment (for instance, establishment of the video telephone, place of the conference, the inside of a car, and so forth) is low in change of the background noise, therefore, either the silence compression coding processing or the speech compression coding processing is selected to be fixed using the first frame.

[0026] As a result thereof, the transmission efficiency and sound quality of the background noise are improved, and the data processing is simplified because the regular coding processing or the silence compression coding processing is not selected in every frame, consequently the data processing does not become complicated, and device size is reduced.

[0027] Furthermore, in the silence compression coding / decoding method and the device of the same of the present invention, the discrimination threshold value is established fixedly, or the discrimination threshold value is variably established automatically by the control signal from the outer section, or the discrimination threshold value is established automatically by control from the outer section.

[0028] As a result, the optimum discrimination threshold value can be established variably corresponding to the background noise of circumferential environment (for instance, location of the video telephone, location of the conference, or inside of the car) to be used, and when the device is applied to the video telephone system, video conference system or digital telephone system, optimum constitution (design) is capable of being achieved while considering the background noise in every use environment.

[0029] The above and further objects and novel features of the invention will be more fully understood from the following detailed description when the same is read in connection with the accompanying drawings. It should be expressly understood, however, that the drawings are for purpose of illustration only and are not intended as a definition of the limits of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

Fig. 1 is a block diagram showing a device constitution concerning conventional silence compression coding / decoding method;

Fig. 2 is a block diagram showing a constitution of a silence compression coding / decoding method and a device of the same according to a first embodiment of the present invention;

Fig. 3 is a block diagram showing a constitution of a silence compression coding / decoding method and a device

of the same according to a second embodiment of the present invention; and

Fig. 4 is a block diagram showing a constitution of a silence compression coding / decoding method and a device of the same according to a third embodiment of the present invention.

PREFERRED EMBODIMENT OF THE PRESENT INVENTION

[0031]   A preferred embodiment of a silence compression coding / decoding method and a device of the same according to the present invention will now be described in detail in accordance with the accompanying drawings.

[0032]·   Fig. 2 is a block diagram showing a constitution of a silence compression coding / decoding method and a device of the same according to a first embodiment of the present invention.

[0033]   The first embodiment is applied to a video telephone system and a video conference system. According to the constitution of the first embodiment, there is provided a silence compression coding selector 11. The silence compression coding selector 11, when the device codes to transmit the input speech signal 'Sd', transmits either silence compression coding output speech signal 'Sno' or regular coding output speech signal 'So' according to background noise level. The silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' is obtained in such a way that the silence compression coding processing or the speech compression coding processing (regular coding processing) according to the background noise level is selected to process.

[0034]   The silence compression coding selector 11 stores therein in-active / active flag to notice to the decoding side. The in-active / active flag indicate whether a frame of the input speech signal is in-active or active.

[0035]   Further, the present embodiment is provided with a transmission line 12 of communication telephone network such as ISDN, PSTN and so forth or private dedicated line, and a decoder 13 for decompressing to decode a silence compression decoding output speech signal 'Sno' received through the transmission line 12 from the silence compression coding selector 11, and for transmitting analog output speech signal 'Sa' which is obtained by decoding the regular coding output speech signal 'So'.

[0036]   The decoder 13 receives the silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' through the transmission line 12 from the silence compression coding selector 11. The silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' is discriminated whether each of them should be processed by the silence compression coding processing or the regular coding processing according to the in-active / active flag which is stored in this frame and is transmitted by upper layer. According to this discrimination, there is implemented either decompression decoding or regular decoding, thus either the decompression decoded analog output speech signal 'Sa' or the regular decoded analog output speech signal 'Sa' is transmitted.

[0037]   The silence compression coding selector 11 is provided with a background noise measuring section 21 for transmitting background noise component level 'Sm' indicating the volume (level) of the background noise while performing filtering-processing using band pass filter and so forth about speech band and the background noise in every frame of the input speech signal 'Sd', and a background noise level discrimination section 22 for transmitting switching signal 'Sw' for selecting either the silence compression coding processing or the regular coding processing concerning the input speech signal 'Sd' (frame), while comparing the background noise component level 'Sm' from the background noise measuring section 21 with discrimination threshold value data 'Srf'.

[0038]   The silence compression coding selector 11 further comprises a silence compression correspondence coder 23 for transmitting the silence compression coding output speech signal 'Sno' undergoing compression coding processing in every frame of the input speech signal 'Sd', a coder 24 for transmitting the regular coding output speech signal 'So' according to regular coding processing in which the silence compression coding processing is not implemented in every frame of the input speech signal 'Sd', a continuous frame discrimination section 25 for transmitting continuous frame discrimination signal 'Sp' indicating that the input speech signal 'Sd' is continuous signal, a discrimination threshold value establishing section 26 for transmitting discrimination threshold value data 'Srf' which comes into comparison reference for selecting either the silence compression coding processing or the regular coding processing according to the background noise component level 'Sm' from the background noise measuring section 21, and switches SW1, SW2 for selecting or not-selecting input-side or output-side of the silence compression correspondence coder 23 or the coder 24 using switching signal 'Sw'.

[0039]   The discrimination threshold value establishing section 26 is provided with a variable establishing section VR for variably establishing level (threshold value) of the discrimination threshold value data 'Srf'.

[0040]   The switch SW1 supplies the input speech signal 'Sd' to either the silence compression correspondence coder 23 or the coder 24 which are connected to fixed contacts in such a way that the input speech signal 'Sd' is supplied to movable contact and the SW1 is switched by the switching signal 'Sw' from the background noise level discrimination section 22.

[0041]   Further, the movable contact of the switch SW2 is switched by the switching signal 'Sw' from the background noise level discrimination section 22 resulting in connection to the fixed contact. Thus, either the silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' from respective output terminals of the silence compression correspondence coder 23 or the coder 24 which are connected to the fixed contacts are selected to be transmitted to the transmission line 12.

[0042] Next, there will be described operation of a first embodiment.

[0043] The input speech signal 'Sd' is supplied to the background noise measuring section 21 and the continuous frame discrimination section 25. In the continuous frame discrimination section 25, a continuous frame discrimination signal 'Sp' indicating that the input speech signal 'Sd' is the continuous frame is outputted to the discrimination threshold value establishing section 26. Further, in the background noise measuring section 21, speech band component is extracted in every inputted frame by filtering processing of the band pass filter. A balance processing in which the speech band component data undergoes phase inversion from the input speech signal 'Sd' and the phase inverted speech band component data is added is implemented to pick out the background noise component.

[0044] The background noise component level 'Sm' picked out from the background noise measuring section 21 is inputted to the background noise level discrimination section 22. The discrimination threshold value data 'Srf' is transmitted to the background noise level discrimination section 22 in answer to the continuous frame discrimination signal 'Sp' namely being transmitted continuously in every frame, from the discrimination threshold value establishing section 26. The discrimination threshold value data 'Srf' from the discrimination threshold value establishing section 26 is adjusted to be established in a variable establishing section VR described after.

[0045] In the background noise level discrimination section 22, when the background noise component level 'Sm' from the background noise measuring section 21 exceeds the discrimination threshold value data 'Srf' from the discrimination threshold value establishing section 26, the background noise level discrimination section 22 transmits the switching signal 'Sw' in order to select the coder 24 to the switches SW1, SW2. On the other hand, when the background noise component level 'Sm' does not exceed the discrimination threshold value data 'Srf', the background noise level discrimination section 22 transmits the switching signal 'Sw' in order to select the silence compression correspondence coder 23 to the switches SW1, SW2.

[0046] Namely, when the background noise component level 'Sm' exceeds the discrimination threshold value data 'Srf', the regular coding processing is selected. Further, when the background noise component level 'Sm' does not exceed the discrimination threshold value data 'Srf', the silence compression coding processing is selected. Each of the regular coding output speech signal 'So' from the coder 24 or the silence compression coding output speech signal 'Sno' from the silence compression correspondence coder 23 is transmitted to the decoder 13 through the transmission line 12.

[0047] In the decoder 13, when the regular coding output speech signal 'So' is inputted therein from the coder 24 of the silence compression coding selector 11, the decoder 13 implements regular decoding processing without implementing decompression processing to transmit an analog output speech signal 'Sa'.

[0048] Further, in the decoder 13, when the silence compression coding output speech signal 'Sno' is inputted from the silence compression correspondence coder 23 of the silence compression coding selector 11, the decoder 13 transmits an analog output speech signal 'Sno' undergoing decompression processing.

[0049] In this decoding processing, the silence compression coding selector 11 stores the in-active / active flag indicating whether the frame is in-active or active into the decoder 13 in order to notice to the decoder 13. The decoder 13 transmits the analog output speech signal 'Sa' which is obtained by decoding the regular coding output speech signal 'So' as being the speech compression coding data according to the active flag noticed. On the other hand the decoder 13 transmits the analog output speech signal 'Sa' while implementing decoding processing which decompresses the silence compression coding output speech signal 'Sno' to be the silence compression coding data according to the in-active flag to transmit the analog output speech signal 'Sa'.

[0050] Thus, either the silence compression coding processing or the speech compression coding processing is selected while comparing the background noise component level 'Sm' with the discrimination threshold value data 'Srf'. When the background noise always undergoes the silence compression coding processing and the decoding, sound quality of the background noise deteriorates, thus speech is disagreeable to listen, therefore, either the silence compression coding processing or the speech compression coding processing (regular coding processing) is selected while comparing the background noise component level 'Sm' with the discrimination threshold value data 'Srf' so as not to come to be disagreeable to listen to.

[0051] In this case, when the background noise level is large, the background noise is coded by the speech compression coding processing to transmit, therefore, the transmission efficiency deteriorates slightly in comparison with the case where the whole background noise undergoes the silence compression coding processing, however, the transmission efficiency does not deteriorate largely, thus the transmission efficiency is improved. Further, the background noise in the analog output speech signal 'Sa' decoded by the decoder 13 does not generate deterioration of sound quality, thus speech quality is improved.

[0052] The variable establishment of the discrimination threshold value establishing section 26 provided with the variable establishing section VR, namely, the discrimination threshold value data 'Srf' is established to the level which selects either the silence compression coding processing or the speech compression coding processing, so the decoded analog output speech signal 'Sa' does not come to be disagreeable sound quality to listen. In this case, the variable establishing section VR is established manually, while when the device is applied to the video telephone system, or the video conference system the variable establishing section VR is established automatically while considering the background noise of the establishment place described in a third embodiment.

[0053] Next, there will be described a second embodiment.

[0054] Fig. 3 is a block diagram showing a constitution of the second embodiment.

[0055] The second embodiment is also applied to a video telephone system and a video conference system.

According to the constitution of the second embodiment, there is provided a silence compression coding selector 11. The silence compression coding selector 11, when the device codes to transmit the input speech signal 'Sd', transmits either silence compression coding output speech signal 'Sno' or regular coding output speech signal 'So'. The silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' is obtained in such a way that the silence compression coding processing or the speech compression coding processing (regular coding processing) according to the background noise level is selected to process.

[0056] The silence compression coding selector 11 stores therein in-active / active flag to notice to the decoding side. The in-active / active flag indicate whether a frame of the input speech signal is in-active or active.

[0057] Further, the present second embodiment is provided with a transmission line 12 of communication telephone network such as ISDN, PSTN and so forth or private dedicated line, and a decoder 13 for decompressing to decode a silence compression decoding output speech signal 'Sno' received through the transmission line 12 from the silence compression coding selector 11, and for transmitting analog output speech signal 'Sa' which is obtained by decoding the regular coding output speech signal 'So'.

[0058] The decoder 13 receives the silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' through the transmission line 12 from the silence compression coding selector 11. The silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' is discriminated whether each of them should be processed by the silence compression coding processing or the regular coding processing according to the in-active / active flag which is stored in this frame and is transmitted by upper layer. According to this discrimination, there is implemented either decompression decoding or regular decoding, thus decompression decoded analog output speech signal 'Sa' or regular decoded analog output speech signal 'Sa' is transmitted.

[0059] The silence compression coding selector 11 is provided with a background noise measuring section 21 for transmitting background noise component level 'Sm' indicating the volume (level) of the background noise while performing filtering-processing using band pass filter and so forth about speech band and the background noise in every frame of the input speech signal 'Sd', and a background noise level discrimination section 22 for transmitting switching signal 'Sw' for selecting either the silence compression coding processing or the regular coding processing concerning the input speech signal 'Sd' (frame), while comparing the background noise component level 'Sm' from the background noise measuring section 21 with discrimination threshold value data 'Srf'.

[0060] The silence compression coding selector 11 further comprises a silence compression correspondence coder 23 for transmitting the silence compression coding output speech signal 'Sno' undergoing compression coding processing in the first frame of the input speech signal 'Sd', a coder 24 for transmitting the regular coding output speech signal 'So' according to regular coding processing in which the silence compression coding processing is not implemented in every frame of the input speech signal 'Sd', a first frame discrimination section 30 for transmitting a first frame discrimination signal 'Spa' indicating discrimination result after discriminating the first frame of the input speech signal 'Sd', a discrimination threshold value establishing section 26 for transmitting discrimination threshold value data 'Srf' which comes into comparison reference for selecting either the silence compression coding processing or the regular coding processing according to the background noise component level 'Sm' from the background noise measuring section 21, and switches SW1, SW2 for selecting or not-selecting input-side or output-side of the silence compression correspondence coder 23 or the coder 24 using switching signal 'Sw'.

[0061] The discrimination threshold value establishing section 26 is provided with a variable establishing section VR for variably establishing level (threshold value) of the discrimination threshold value data 'Srf'.

[0062] The switch SW1 supplies the input speech signal 'Sd' to either the silence compression correspondence coder 23 or the coder 24 which are connected to fixed contacts in such a way that the input speech signal 'Sd' is supplied to movable contact and the SW1 is switched by the switching signal 'Sw' from the background noise level discrimination section 22.

[0063] Further, the movable contact of the switch SW2 is switched by the switching signal 'Sw' from the background noise level discrimination section 22 resulting in connection to the fixed contact. Thus, either the silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' from respective output terminals of the silence compression correspondence coder 23 or the coder 24 which are connected to the fixed contacts are selected to be transmitted to the transmission line 12.

[0064] Next, there will be described operation of the second embodiment.

[0065] The first frame discrimination section 30 discriminates the first frame of the input speech signal 'Sd', before transmitting the first frame discrimination signal 'Spa' toward the discrimination threshold value establishing section 26. The first frame discrimination section 30 transmits the first frame discrimination signal 'Spa' according to only the first frame, not transmitting the first frame discrimination signal after the first transmission. The discrimination threshold value establishing section 26 transmits the discrimination threshold value data 'Srf' established in the variable establishing section VR toward the background noise level discrimination section 22 in the subsequent frame according to the first frame discrimination signal 'Spa'.

[0066] Consequently, in the background level discrimination section 22, when the background noise component level 'Sm' measured in the first frame from the background noise measuring section 21 is inputted therein, before comparing the background noise component level 'Sm' with the discrimination threshold value data 'Srf', in the subsequent frame, thus this selection continues. Namely, when the background noise component level 'Sm' according to the first frame exceeds the discrimination threshold value data 'Srf', the switching signal 'Sw' is transmitted in order to select the coder 24 toward the switches SW1, SW2. Further, when the background noise component level 'Sm'

according to the first frame does not exceed the discrimination threshold value data 'Srf', the switching signal 'Sw' in order to select the silence compression correspondence coder 23 is transmitted to the switches SW1, SW2.

[0067]   Thus, either the silence compression coding processing or the speech compression coding processing (regular coding processing) is selected using only the first frame, in the subsequent frame, this selection continues. The background noise does not change within the speech. Namely, in the middle of the speech, the speaker does not move from the place, in the circumferential environment (for instance, establishment of the video telephone, place of the conference, the inside of a car, and so forth) is low in change of the background noise, therefore, either the silence compression coding processing or the speech compression coding processing is selected to be fixed using the first frame. Consequently, the data processing does not become complicated, and device size is reduced.

[0068]   Next, there will be described a third embodiment.

[0069]   Fig. 4 is a block diagram showing a constitution of the third embodiment.

[0070]   The third embodiment is applied to a video telephone system and a video conference system. According to the constitution of the third embodiment, there is provided a silence compression coding selector 11. The silence compression coding selector 11, when the device codes to transmit the input speech signal 'Sd', transmits either silence compression coding output speech signal 'Sno' or regular coding output speech signal 'So'. The silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' is obtained in such a way that the silence compression coding processing or the speech compression coding processing (regular coding processing) according to the background noise level is selected to process.

[0071]   The silence compression coding selector 11 stores therein in-active / active flag to notice to the decoding side. The in-active / active flag indicate whether a frame of the input speech signal is in-active or active.

[0072]   Further, the present third embodiment is provided with a transmission line 12 of communication telephone network such as ISDN, PSTN and so forth or private dedicated line, and a decoder 13 for decompressing to decode a silence compression decoding output speech signal 'Sno' received through the transmission line 12 from the silence compression coding selector 11, and for transmitting analog output speech signal 'Sa' which is obtained by decoding the regular coding output speech signal 'So'.

[0073]   The decoder 13 receives the silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' through the transmission line 12 from the silence compression coding selector 11. The silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' is discriminated whether each of them should be processed by the silence compression coding processing or the regular coding processing according to the in-active / active flag which is stored in this frame and is transmitted by upper layer. According to this discrimination, there is implemented either decompression decoding or regular decoding, thus decompression decoded analog output speech signal 'Sa' or regular decoded analog output speech signal 'Sa' is transmitted.

[0074]   The silence compression coding selector 11 is provided with a background noise measuring section 21 for transmitting background noise component level 'Sm' indicating the volume (level) of the background noise while performing filtering-processing using band pass filter and so forth about speech band and the background noise in every frame of the input speech signal 'Sd', and a background noise level discrimination section 22 for transmitting switching signal 'Sw' for selecting either the silence compression coding processing or the regular coding processing concerning the input speech signal 'Sd' (frame), while comparing the background noise component level 'Sm' from the background noise measuring section 21 with discrimination threshold value data 'Srf'.

[0075]   The silence compression coding selector 11 further comprises a silence compression correspondence coder 23 for transmitting the silence compression coding output speech signal 'Sno' undergoing compression coding processing in every frame of the input speech signal 'Sd', a coder 24 for transmitting the regular coding output speech signal 'So' according to regular coding processing in which the silence compression coding processing is not implemented in every frame of the input speech signal 'Sd', a continuous frame discrimination section 25 for transmitting continuous frame discrimination signal 'Sp' indicating that the input speech signal 'Sd' is continuous signal, a discrimination threshold value establishing section 26 for transmitting discrimination threshold value data 'Srf' which comes into comparison reference for selecting either the silence compression coding processing or the regular coding processing according to the background noise component level 'Sm' from the background noise measuring section 21, and switches SW1, SW2 for selecting or not-selecting input-side or output-side of the silence compression correspondence coder 23 or the coder 24 using switching signal 'Sw'.

[0076]   The discrimination threshold value establishing section 26 is provided with an establishment control section 32 for variably establishing level (threshold value) of the discrimination threshold value data 'Srf' according to a control signal 'Sc' from an outer section.

[0077]   The switch SW1 supplies the input speech signal 'Sd' to either the silence compression correspondence coder 23 or the coder 24 which are connected to fixed contacts in such a way that the input speech signal 'Sd' is supplied to movable contact and the SW1 is switched by the switching signal 'Sw' from the background noise level discrimination section 22.

[0078]   Further, the movable contact of the switch SW2 is switched by the switching signal 'Sw' from the background noise level discrimination section 22 resulting in connection to the fixed contact. Thus, either the silence compression coding output speech signal 'Sno' or the regular coding output speech signal 'So' from respective output terminals of the silence compression correspondence coder 23 or the coder 24 which are connected to the fixed contacts are selected to be transmitted to the transmission line 12.

[0079]   Next, there will be described operation of the third embodiment.

[0080]   The third embodiment operates similarly to the first embodiment shown in Fig. 2. However, the difference therebetween is that the discrimination threshold value establishing section 26 establishes automatically the discrimination threshold value data 'Srf' into a level for selecting either the silence compression coding processing or the speech compression coding processing so as not to come to be disagreeable sound quality (speech) when decoding the discrimination threshold value data 'Srf'. For instance, when this device is applied to the video telephone system or the video conference system, the discrimination threshold value data 'Srf' of the background noise level is automatically established while considering the background noise level of individual establishment place. In this case, the device inputs therein the control signal 'Sc' which is capable of establishing the discrimination threshold value data 'Srf' so as to come to be agreeable speech to listen due to the fact that deterioration of sound quality of the background noise is reduced when decoding it.

[0081]   Further, the third embodiment is capable of being applied to the second embodiment.

[0082]   Furthermore, in the first to third embodiments, this constitution is applied to the video telephone system or the video conference system, there is described about the coding and the decoding in the speech transmission. However, similarly, it is capable of being applied to CODEC processing in which the coding and the decoding in cellular mobile telephone system (PDC / PHS / DECT and so forth) for implementing only digital speech transmission.

[0083]   As is clear from the above description, according to the silence compression coding / decoding method and device of the same of the present invention, the device compares the background noise component level taken out in every frame of the input speech signal with the discrimination threshold value, thus when the background noise component level exceeds the discrimination threshold value, the device selects the regular coding processing, while when the background noise component level does not exceed the discrimination threshold value, the device selects the silence compression coding processing, before transmitting either coding data or silence compression coding data.

[0084]   As a result, in the present method and device, the transmission efficiency slightly decreases, however the transmission efficiency does not decrease largely, in comparison with the case where the background noise is coded by speech compression coding processing to transmit, thus the whole background noise undergoes the silence compression coding processing, so that the transmission efficiency is improved. Further, the sound quality of the background noise at the time of decoding is improved, thus speech of high quality becomes possible.

[0085]   Further, according to the silence compression coding / decoding method and device of the same of the present invention, since change of the background noise at circumferential environment during speech, the device compares the background noise component level in the first frame of the input speech signal with the discrimination threshold value, the processing is fixed into either the regular coding processing or the silence compression coding processing in subsequent frame.

[0086]   As a result, the transmission efficiency and sound quality of the background noise are improved, and the data processing is simplified because the regular coding processing or the silence compression coding processing is not selected in every frame, device size is reduced.

[0087]   Furthermore, according to the silence compression coding / decoding method and device of the same of the present invention, the discrimination threshold value is established fixedly, or the discrimination threshold value is variably established automatically by the control signal from the outer section, or the discrimination threshold value is established automatically by control from the outer section.

[0088]   As a result, the optimum discrimination threshold value can be established variably corresponding to the background noise of circumferential environment to be used, and when the device is applied to the video telephone system, video conference system or digital telephone system, optimum constitution (design) is capable of being achieved while considering the background noise in every use environment.

[0089]   While preferred embodiments of the invention have been described using specific terms, the description has been for illustrative purpose only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

Claims

1. A compression coding / decoding method in which an in-active interval of an input speech signal is subjected to a compression coding before implementing decompression decoding, comprising the steps of:

    picking out a background noise component in every input frame;

    comparing background noise level of said background noise component in every said input frame with a discrimination threshold value; and

    selecting regular coding processing when background noise component level exceeds said discrimination threshold value in every said input frame, while when background noise level does not exceed said discrimination threshold value, compression coding processing is selected in every said input frame.

2. A compression coding / decoding method in which an in-active interval of an input speech signal is subjected to a compression coding before implementing decompression decoding, comprising the steps of:

    picking out a background noise component of a first frame of said input speech signal;

comparing background noise level of the background noise component of the first frame with a discrimination threshold value; and

selecting regular coding processing in subsequent frames when background noise component level of said first frame exceeds said discrimination threshold value in every said input frame, while when background noise level of said first frame does not exceed said discrimination threshold value, compression coding processing is selected in subsequent input frame.

3. A silence compression coding / decoding method as claimed in claim 1, wherein said discrimination threshold value is any of a fixed value determined previously, a semi-fixed value according to manual establishment, and a variable establishment value variably established automatically by control signal from outer section.

4. A silence compression coding / decoding method as claimed in claim 2, wherein said discrimination threshold value is any of a fixed value determined previously, a semi-fixed value according to manual establishment, and a variable establishment value variably established automatically by control signal from outer section.

5. A silence compression coding / decoding method as claimed in claim 1, wherein said coding processing notices either an in-active flag or an active flag indicating either silence compression processing or speech compression coding processing toward decoding side, thus implementing either decompression decoding processing or non-decompression decoding processing according to this notification.

6. A silence compression coding / decoding method as claimed in claim 2, wherein said coding processing notices either an in-active flag or an active flag indicating either silence compression processing or speech compression coding processing toward decoding side, thus implementing either decompression decoding processing or non-decompression decoding processing according to this notification.

7. A silence compression coding / decoding device having a coder and decoder, for implementing compression coding to an in-active interval of an input speech signal, before implementing decompression decoding thereto, wherein said coder comprises:

a coding means for coding an input speech signal to output in every frame;

a compression coding means for compression coding the input speech signal to output in every frame;

a background noise measuring means for picking out a background noise component in every frame of the input speech signal;

a background noise level discrimination means for comparing a background noise level from said background noise measuring means with a discrimination threshold value in every frame; and

a selecting means, in said background noise level discrimination means, for selecting said coding means in every frame when background noise component level exceeds said discrimination threshold value, while when said background noise level does not exceed the discrimination threshold value, said selecting means selects said compression coding means in every frame.

8. A silence compression coding / decoding device having a coder and decoder, for implementing compression coding to an in-active interval of an input speech signal, before implementing decompression decoding thereto, wherein said coder comprises:

a coding means for coding an input speech signal to output;

a compression coding means for compression coding the input speech signal to output;

a background noise measuring means for picking out a background noise component from the input speech signal in a first frame;

a background noise level discrimination means for comparing a background noise level from said background noise measuring means with a discrimination threshold value in the first frame; and

a selecting means, in said background noise level discrimination means, for selecting said coding means in subsequent frame when background noise component level of the first frame exceeds said discrimination threshold value, while when said background noise level of the first frame does not exceed the

discrimination threshold value, said selecting means selects said compression coding means in subsequent frame.

9. A silence compression coding / decoding device as claimed in claim 7, further comprising an establishing means for establishing said discrimination threshold value as a fixed value determined beforehand.

10. A silence compression coding / decoding device as claimed in claim 8, further comprising an establishing means for establishing said discrimination threshold value as a fixed value determined beforehand.
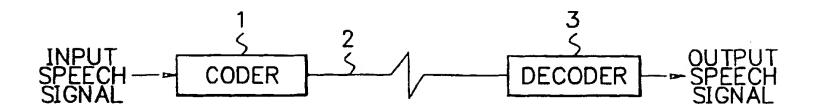
11. A silence compression coding / decoding device as claimed in claim 7, further comprising a manual operation variable establishing means for establishing said discrimination threshold value as a semi-fixed value according to manual operation establishment.
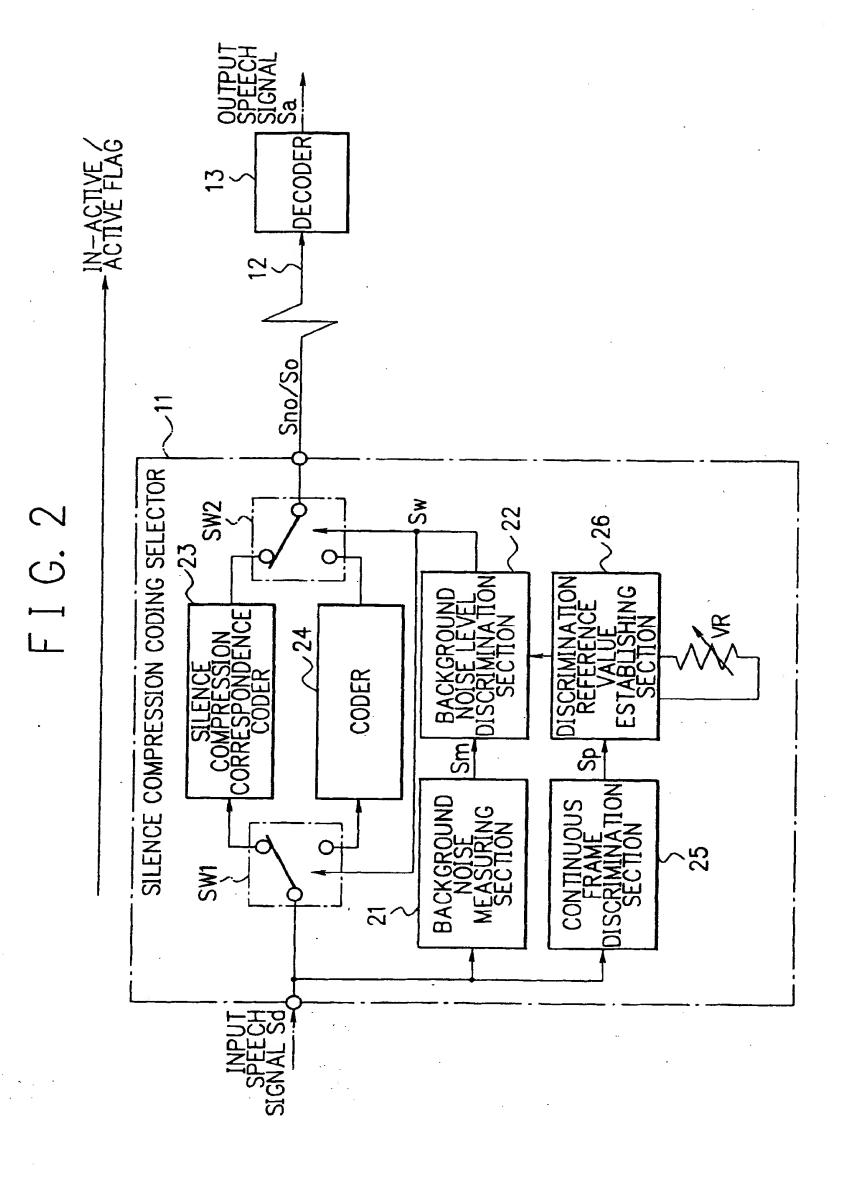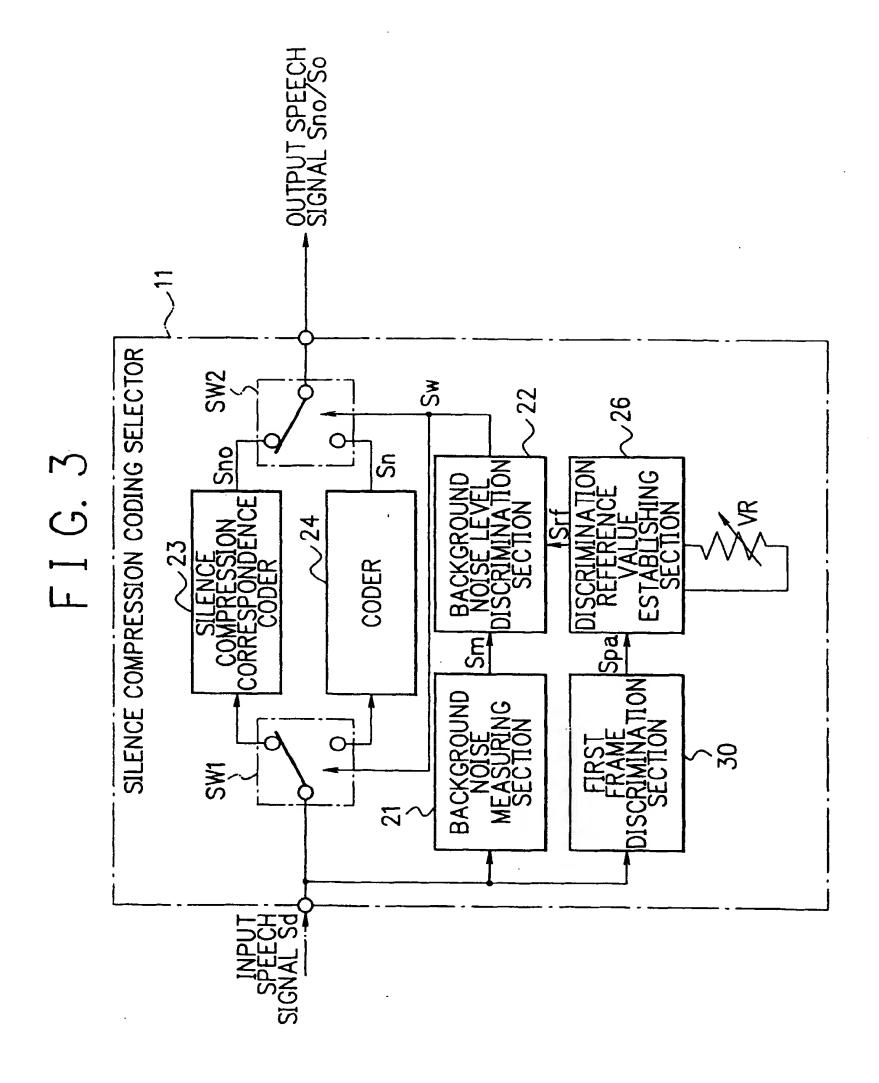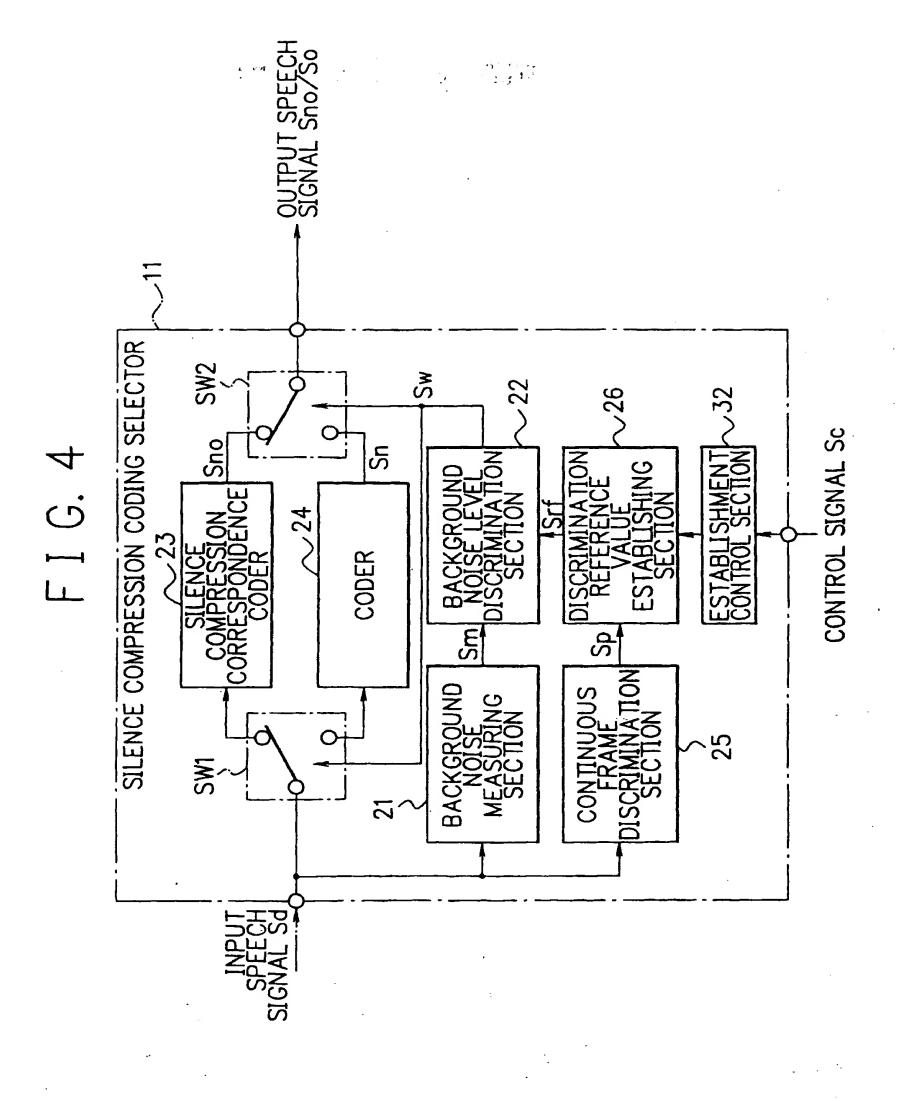
12. A silence compression coding / decoding device as claimed in claim 8, further comprising a manual operation variable establishing means for establishing said discrimination threshold value as a semi-fixed value according to manual operation establishment.

13. A silence compression coding / decoding device as claimed in claim 7, further comprising an automatic variable establishing means for automatically establishing variably said discrimination threshold value according to control signal from an external section.

14. A silence compression coding / decoding device as claimed in claim 8, further comprising an automatic variable establishing means for automatically establishing variably said discrimination threshold value according to control signal from an external section.

15. A silence compression coding / decoding device as claimed in claim 7, wherein said background noise measuring means picks out the background noise component in such a way that said background noise measuring means extracts speech band component from the frame of the input speech signal before implementing subtraction processing in order to subtract said speech band component of the frame.

16. A silence compression coding / decoding device as claimed in claim 8, wherein said background noise measuring means picks out the background noise component in such a way that said background noise measuring means extracts speech band component from the frame of the input speech signal before implementing subtraction processing in order to subtract said speech band component of the frame.

17. A silence compression coding / decoding device as claimed in claim 7, wherein when said coder implements coding processing, said coder transmits either an in-active flag or an active flag indicating either silence compression coding processing or speech compression coding processing to said decoder, before said decoder implements either decompression decoding processing or non-decompression decoding processing according to this notification.

18. A silence compression coding / decoding device as claimed in claim 8, wherein when said coder implements coding processing, said coder transmits either an in-active flag or an active flag indicating either silence compression coding processing or speech compression coding processing to said decoder, before said decoder implements either decompression decoding processing or non-decompression decoding processing according to this notification.

19. A silence compression coding / decoding device as claimed in claim 17, wherein said coder stores said in-active flag or said active flag in said frame before transmitting said flag in order to notice to said decoder.

20. A silence compression coding / decoding device as claimed in claim 18, wherein said coder stores said in-active flag or said active flag in said frame before transmitting said flag in order to notice to said decoder.

F I G. 1
PRIOR ART

```
INPUT                1                2                  3              OUTPUT
SPEECH ──▷ │ CODER │ ───── ─/ /─ ───── │ DECODER │ ─▷  SPEECH
SIGNAL                                                                  SIGNAL
```

FIG. 2

INPUT SPEECH SIGNAL Sd

SILENCE COMPRESSION CODING SELECTOR 11

SW1

SILENCE COMPRESSION CORRESPONDENCE CODER 23

SW2

CODER 24

Sw

BACKGROUND NOISE MEASURING SECTION 21

Sm

BACKGROUND NOISE LEVEL DISCRIMINATION SECTION 22

CONTINUOUS FRAME DISCRIMINATION SECTION 25

Sp

DISCRIMINATION REFERENCE VALUE ESTABLISHING SECTION 26

VR

Sno/So

12

DECODER 13

OUTPUT SPEECH SIGNAL Sa

IN-ACTIVE / ACTIVE FLAG

F I G. 3

SILENCE COMPRESSION CODING SELECTOR 11

INPUT SPEECH SIGNAL Sd

OUTPUT SPEECH SIGNAL Sno/So

SW2

Sno

SW1

23 SILENCE COMPRESSION CORRESPONDENCE CODER

24 CODER

Sn

Sw

22 BACKGROUND NOISE LEVEL DISCRIMINATION SECTION

Sm

21 BACKGROUND NOISE MEASURING SECTION

26 DISCRIMINATION REFERENCE VALUE ESTABLISHING SECTION

Srf

Spa

30 FIRST FRAME DISCRIMINATION SECTION

VR

FIG. 4

SILENCE COMPRESSION CODING SELECTOR ~11

INPUT SPEECH SIGNAL Sd

OUTPUT SPEECH SIGNAL Sno/So

SW1

SW2

Sno

Sn

Sw

SILENCE COMPRESSION CORRESPONDENCE CODER ~23

CODER ~24

BACKGROUND NOISE MEASURING SECTION 21~

BACKGROUND NOISE LEVEL DISCRIMINATION SECTION ~22

CONTINUOUS FRAME DISCRIMINATION SECTION ~25

DISCRIMINATION REFERENCE VALUE ESTABLISHING SECTION ~26

ESTABLISHMENT CONTROL SECTION ~32

Sm

Sp

Srf

CONTROL SIGNAL Sc

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